C L A I M S

1. A vertical heat processing apparatus comprising:

a process chamber defining a process field configured to accommodate a plurality of target substrates supported at intervals in a vertical direction;

a heating furnace surrounding the process chamber, and including an electric heater configured to heat the process field from outside the process chamber;

an electric blower configured to send a cooling gas into the heating furnace, so as to cool the process field by the cooling gas from outside the process chamber;

a temperature sensor configured to detect a temperature inside the process field; and

a control section configured to control the heater and the blower in accordance with detection data obtained by the temperature sensor,

wherein, when the control section conducts temperature control to change a temperature of the process field from an initial temperature to a target temperature higher than the initial temperature but within a range of 100 to 500℃, the control section executes, in order to converge the process field to the target temperature,

performing power feeding to the heater at a first

supply rate or more to heat up the process field to a predetermined temperature immediately below the target temperature,

at a time point when the process field reaches the predetermined temperature, decreasing the power feeding to the heater to a rate lower than the first supply rate, and

then, while setting the power feeding to the heater at a rate lower than the first supply rate, supplying the cooling gas from the blower to forcibly cool the process field.

2. The apparatus according to claim 1, wherein the control section conducts the temperature control to further execute, after forcibly cooling the process field, decreasing power feeding to the blower and increasing the power feeding to the heater to maintain the process field at the target temperature.

3. The apparatus according to claim 1, wherein the control section keeps power feeding to the blower constant in heating the process field to the predetermined temperature and in forcibly cooling the process field.

4. The apparatus according to claim 1, wherein the control section uses a higher rate of power feeding to the blower in forcibly cooling the process field than in heating the process field to the predetermined temperature.

5. The apparatus according to claim 4, wherein the control section uses one control variable to control the power feeding to the heater and the power feeding to the blower, and the control variable is arranged to increase the power feeding to the heater as an absolute value of the control variable increases in a positive direction, and to increase the power feeding to the blower as an absolute value of the control variable increases in a negative direction.

6. The apparatus according to claim 5, wherein the control section stops the power feeding to the blower in heating the process field to the predetermined temperature.

7. The apparatus according to claim 5, wherein the control section stops the power feeding to the heater in forcibly cooling the process field.

8. The apparatus according to claim 7, wherein the control section conducts the temperature control to further execute, after forcibly cooling the process field, stopping the power feeding to the blower and restarting the power feeding to the heater to maintain the process field at the target temperature.

9. The apparatus according to claim 1, wherein the predetermined temperature is preset to be 20 to 80℃ lower than the target temperature.

10. The apparatus according to claim 1, wherein the process chamber comprises a quartz body portion

corresponding to the process field, and a quartz upper portion and a quartz lower portion present above and below the body portion, respectively, and the body portion has a wall thickness smaller than that of the upper portion and the lower portion.

11. The apparatus according to claim 10, wherein the body portion differs from the upper portion and the lower portion in wall thickness by 4 mm or less.

12. A method of controlling a vertical heat processing apparatus,

the apparatus comprising

a process chamber defining a process field configured to accommodate a plurality of target substrates supported at intervals in a vertical direction,

a heating furnace surrounding the process chamber, and including an electric heater configured to heat the process field from outside the process chamber, and

an electric blower configured to send a cooling gas into the heating furnace, so as to cool the process field by the cooling gas from outside the process chamber, and

when the method conducts temperature control to change a temperature of the process field from an initial temperature to a target temperature higher than the initial temperature but within a range of 100 to 500℃,

the method comprising, in order to converge the process field to the target temperature:

performing power feeding to the heater at a first supply rate or more to heat up the process field to a predetermined temperature immediately below the target temperature,

at a time point when the process field reaches the predetermined temperature, decreasing the power feeding to the heater to a rate lower than the first supply rate, and

then, while setting the power feeding to the heater at a rate lower than the first supply rate, supplying the cooling gas from the blower to forcibly cool the process field.

13. The method according to claim 12, wherein the method further comprises, after forcibly cooling the process field, decreasing power feeding to the blower and increasing the power feeding to the heater to maintain the process field at the target temperature.

14. The method according to claim 12, wherein the method keeps power feeding to the blower constant in heating the process field to the predetermined temperature and in forcibly cooling the process field.

15. The method according to claim 12, wherein the method uses a higher rate of power feeding to the blower in forcibly cooling the process field than in heating the process field to the predetermined

temperature.

16. The method according to claim 15, wherein the method uses one control variable to control the power feeding to the heater and the power feeding to the blower, and the control variable is arranged to increase the power feeding to the heater as an absolute value of the control variable increases in a positive direction, and to increase the power feeding to the blower as an absolute value of the control variable increases in a negative direction.

17. The method according to claim 16, wherein the method stops the power feeding to the blower in heating the process field to the predetermined temperature.

18. The method according to claim 16, wherein the method stops the power feeding to the heater in forcibly cooling the process field.

19. The method according to claim 18, wherein the method further comprises, after forcibly cooling the process field, stopping the power feeding to the blower and restarting the power feeding to the heater to maintain the process field at the target temperature.

20. The method according to claim 12, wherein the predetermined temperature is preset to be 20 to 80℃ lower than the target temperature.